

## **HIGH VOLTAGE TOLERANCE EMULATION USING VOLTAGE CLAMP FOR OXIDE STRESS PROTECTION**

### **ABSTRACT**

Circuits, methods, and apparatus for limiting voltages received by devices in input/output cells to less than the device's breakdown voltage. An exemplary embodiment of the present invention provides an input/output cell having one or more clamp diodes and resistors configured to limit voltages seen by the gates of the devices in the input/output cell. In one embodiment, the clamp diodes are on-chip, while the resistors are off-chip. In a specific embodiment, the clamp diode is connected between an input pad for the input output cell and a supply voltage VCC, while a resistor is off-chip and in series with the input pad. In another specific embodiment, a series of clamp diodes are coupled between ground and an input pad, while a resistor is off-chip and in series with the input pad. In another embodiment, the clamp diode or diodes may be programmably or selectively disconnected. These clamp diodes may be disabled to protect against latch-up. Integrated circuits that are consistent with the present invention may include one or more of these and the other features described.

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